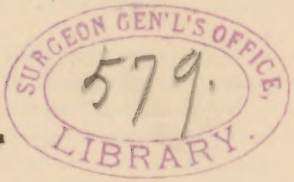
Wilcox (R. W.)

The Indigestion of Starchy Foods.

* * *

By Reynold W. Wilcox, M.D., LL.D.,

Professor of Clinical Medicine and Therapeutics at the New York Post-Graduate Medical School and Hospital; Visiting Physician to St. Mark's Hospital, New York.



* * *

Press of
Parke, Davis & Co.
1896.

THE SYMPTOMS AND DIAGNOSIS OF THE INDIGESTION OF STARCHY FOODS.*

BY REYNOLD W. WILCOX, M.D., LL.D.,
OF NEW YORK;
Professor of Clinical Medicine and Therapeutics at the New York Post-Graduate Medical School and Hospital; Visiting Physician to St. Mark's Hospital

There are many reasons why the text-books are silent upon the subject of this paper. The ease with which the contents of the stomach can be examined, the accuracy with which the effect of pepsin can be estimated, the zeal and energy of the manufacturers of digestive ferments, have placed our knowledge of gastric digestion in a very satisfactory condition. To one who will carefully study the accurate work of Hayem and Winter, and who will follow their teachings, the chemistry and physiology of the gastric fluids are well understood. Yet, after all, the gastric may be stated to be only the preliminary to duodenal digestion. And that gastric digestion is not even essential, is shown by observations of Czerny, who demonstrated that a dog could live for five months after his stomach had been removed.

The digestion of starches, it is well known, takes place in the mouth and in the intestine. The older physiologists were of the opinion that the digestion of starches came to an end in the stomach. Kellogg, however, has shown conclusively that starch digestion can go on, under certain conditions, in the stomach. One hundred and forty-nine cases in which starch digestion was especially studied, complete conversion was found in 2 per cent. The conditions under which this is brought about will be considered at a later period.

Starch digestion, according to Brown and Heron, may be represented as follows:

* Read before the Medical Society of the State of New York, at its ninetieth annual session, January 29, 1896, and reprinted from THE MEDICAL NEWS, 1896, Vol. LXVIII, p. 182.

One molecule of gelatinous is converted into *n* molecules of soluble starch.

One molecule of soluble starch—

$$
\begin{aligned}
&10(C_{12}H_{20}O_{10}) \\
&\quad +8(H_2O)=1.\ 9(C_{12}H_{20}O_{10}) \quad \text{Erythro-dextrin.} \\
&\qquad\qquad +(C_{12}H_{22}O_{11}) \quad \text{Maltose.} \\
&\qquad\quad =2.\ 8(C_{12}H_{20}O_{10}) \quad \text{Erythro-dextrin.} \\
&\qquad\qquad +2(C_{12}H_{22}O_{11}) \quad \text{Maltose.} \\
&\qquad\quad =3.\ 7(C_{12}H_{20}O_{10}) \quad \text{Achroo-dextrin.} \\
&\qquad\qquad +3(C_{12}H_{22}O_{11}) \quad \text{Maltose.} \\
&\qquad\qquad \text{And so on, the resultant being:} \\
&\qquad\quad =\ 8(C_{12}H_{22}O_{11}) \quad \text{Maltose.} \\
&\qquad\qquad +2(C_{12}H_{20}O_{10}) \ \text{Achroo-dextrin.}
\end{aligned}
$$

We will now consider this digestion as it takes place at the various portions of the alimentary canal.

The term buccal dyspepsia has been used for more than a score of years. It was supposed to be characterized by insufficient nutrition, resulting in emaciation, abdominal distention, flatulence, and colicky pains, or abdominal distress, and was due to imperfect conversion of the starches in the mouth. Investigation subsequently showed that this imperfect conversion was but a part, and perhaps a minor part, of the causation, the more important being hasty mastication. The hasty mastication resulted in (1) imperfect breaking up of the starch grains, (2) deficient quantity of saliva, and (3) imperfect insalivation. Since the conversion of insoluble starch into soluble sugar depends upon not only a sufficient amount of saliva, but also upon trituration of the starch grains so that their capsules shall be thoroughly ruptured, and thorough mixture of the saliva with the starch, it can readily be seen how very important is complete mastication. With these three factors in full play, starch conversion is practically instantaneous. Naturally a considerable portion in this form of indigestion—so-called buccal dyspepsia—can be cured by eating more slowly, on the one hand, and by limitation of the starchy foods which are ingested, on the other. This cause of dyspepsia is far more frequent than it is popularly supposed to be, and the neglect to properly appreciate this etiological factor explains some of the failures in therapeutics of those who place great reliance upon the results of the examination of the stomach contents. The careless hurrying of the carbo-hydrates into the stomach without their being properly acted upon by the ptyalin

of the secretions of the mouth is, as I have said before, a very important cause of dyspepsia. Lees has recently called attention to another prevalent error, which is frequently, I imagine, even encouraged by physicians. Too much amylaceous food is taken into the stomach soaked in tea, coffee, milk, beef tea, and other fluids. The result of this is that insalivation is not at all performed, and the ptyalin, quite likely deficient in amount from lack of mastication, is present in such small percentage that it is practically inoperative. The stomach is not expected to originate the digestion of starches; it may, and likely does, continue the process, when commenced in the mouth, for about half an hour. The natural inference from this is that fluids of any kind should not be used while masticating amylaceous food, and the patient should be restricted from the too free use of tea, soups with vegetables, puddings with milk or cream, or boiled farinaceous foods with the same. The results which are obtained in practice tend to show the correctness of the observation. When we consider that, depending upon the dryness and hardness of the food, from one to three pints of saliva are secreted daily, and that the percentage of ptyalin present (in mixed saliva) is according to Frerichs, .0141, the action of the hydrolytic ferment is by no means insignificant. When, from the causes above mentioned, the amount of carbohydrate food daily ingested, which is necessary for an adult, varying, according to Parkes, from twelve ounces (at rest) to sixteen or eighteen ounces in laborious occupation (practically about two-thirds of the total food) is hurried into the stomach with but little conversion, the results to be expected in the intestines are not far to seek. What the effect of the presence of a large amount of unconverted starch in the stomach may be on gastric digestion, is not, so far as I know, determined, nor, indeed, is it within the scope of this present investigation to inquire.

In the stomach it is admitted that the action of the amylolytic ferment, ptyalin, may continue for about half an hour, its activity being finally checked by the fatty acids, or by the free hydrochloric acid, the latter even if in small quantity. On the other hand, it has been stated that when these acids are in organic combination they may favor starch conversion. Recognizing the amylolytic changes by means of the iodine-iodide test (Lugol's solution; starch, blue coloration; erythro-dextrin, red or purple; achroo-dextrin, brownish; the sugar, maltose or glucose, being detected by Fehling's solution) Kellogg found

in the series of cases above mentioned that the purple color of erythro-dextrin was detected in 67.8 per cent., and the brown color of achroo-dextrin in 17.4 per cent. The conditions under which this unusual digestion takes place are pronounced hypopepsia, or to be more accurate, hypopepsia with hypo-acidity. In fact, the state of starch digestion may be a very good index of the degree of total acidity. When Lugol's solution gives a brown coloration or no reaction whatever, complete conversion of starch has taken place and the presence of sugar can be confirmed by the strong reaction given by Fehling's solution. A suggestion may be entertained that the prompt conversion of starch into sugar which takes place under these conditions may result in the rapid absorption of the digested starch so that the conditions are less favorable for the development of acid fermentation than in the presence of a large quantity of unconverted starch. With this observation by Kellogg, I leave the subject of starch conversion in the stomach.

The digestion of starches is resumed in the small intestine. Owing to the inherent difficulties of the subject the various processes have not been so thoroughly worked out. As a matter of fact, buccal and gastric digestion are merely preparatory to the intestinal. In addition, here, proteids and fats as well as starches are digested, and failure in one direction must necessarily result in abnormalities in the other. In 1890 Boas attempted to study experimentally intestinal digestion in man. For this purpose he made use of vomited matter obtained by a reflux of the intestinal fluids into the stomach. He also made use of the stomach tube and of aspiration. Naturally the irritation of the stomach tube, even if the stomach had been previously irrigated, would result in some gastric fluid, so that unmixed intestinal fluid cannot be obtained. The subject was experimented with while fasting, and the reflux from the intestines was favored by his decubitus and by massage of the epigastric region. Although this method is not applicable to the study of intestinal dyspepsia in our patients, yet the observations of Boas had a certain practical value in that they demonstrated the influence of bad gastric upon the intestinal digestion. Perhaps the sole result of these experiments, so far as concerns starch digestion, is the statement that patients suffering from *hypochlorhydrie* do not suffer from intestinal troubles; in other words, this is confirmatory of Kellogg's work, which shows that under these conditions starch is digested in the stomach, and the opportunity for intestinal

disturbance from undigested starch is not presented. Another factor of importance in intestinal digestion is the presence of micro-organisms, whereas normal gastric digestion is probably free from them. The conditions favorable to the action of amylopsin are similar to those favorable to the action of ptyalin; namely, moderate heat, a slightly alkaline medium and removal of the changed material from time to time. The ferment in the pancreatic juice, distinctly amylolytic (amylopsin), cannot be distinguished from ptyalin. The digestion of starches results in maltose or glucose, the latter being always the final result. Obviously here we must consider that the effect of the pancreatic fluid on starch may be practically inhibited by the discharge of a large amount of acid fluid through a patulous pyloric orifice in cases of marked gastric acidity—another point at which gastric and intestinal indigestion approach. The succus entericus from Lieberkuhn's glands is believed to convert starch into sugar, but under what condition and to what extent physiological literature is generally silent.

So far as the difference in the digestion of starches at the various points is concerned we may follow Kirke in stating that while the pancreatic and intestinal juices are able to turn the achroo-dextrin which remains into maltose, and maltose into glucose (dextrose) it is doubtful whether saliva possesses the same power.

The difficulty of reaching the diagnosis of the indigestion of starches in the intestine is already apparent, yet we believe that in a given number of instances it can be arrived at with reasonable certainty. The importance of making this investigation is great, when we consider that to the assimilation of changed starch we owe much. On the other hand, we have proof, if proof were lacking, that the indigestion of starches is a frequent condition—not so frequent however, as Coutaret in 1870 would have us believe, 60 per cent. of dyspeptics—by the prevalence and somewhat good repute of dyspepsia cures based on raw beef and hot water. And when we consider that in France bread has a prominent place in the dietary and in other European countries starchy foods are even more largely employed, the importance of the subject is apparent. In this country, not only does hasty eating, but bad cooking, and the imperfectly raised biscuit and cakes and other pastry are often saturated with greasy substances, and give us reason to believe that starchy dyspepsia is even more frequent.

Taking up the symptoms of intestinal indigestion as referable to the failure of starch conversion I would place first and foremost constipation, of which the cause is quite likely that the colloid-like unconverted starch does not so readily permit of watery osmosis into the intestine as does the sugar into which it is converted, which acts as a crystalloid. The accumulation of undigested and unabsorbed material may even be considerable and give rise to marked enteroptosis (Glénard). On the other hand diarrhea is comparatively infrequent; however, fermentation may go on briskly so that a large amount of irritating material may be formed and its expulsion takes place. Should diarrhea exist it is likely to be diarrhea alternating with constipation and not the persistent one which may characterize other intestinal conditions.

The symptom next in importance is undoubtedly flatulence, especially that which occurs two or three hours after meals. The question here arises as to how much of this may be due to gases from the imperfect digestion of proteids in the alimentary canal. To clear up the question we must refer to the work which has been done upon various sulphur compounds. Baumann in 1880 propounded the theory that the combined or ethereal sulphates found in the urine were an index of the amount of putrefactive products absorbed from the intestine; these are chiefly indol, phenol and skatol; the latter is practically of no importance in this study since it is found almost exclusively in the large intestines (Filati). Indol by oxidation becomes potassium indoxyl-sulphate, long known as indican. Looking upon indol as the product of bacteria upon the proteids, as Kuhne and Nencki would have us believe, and considering with this the view of Pisenti that the amount of indican depends largely upon the activity of the pancreatic fluid, we come close to the clinical fact that clay-colored stools, excessive preformed sulphates, and abundant indican in the urine are associated with defective secretion of pancreatic fluid. To Herter and Smith all who study this subject must acknowledge their indebtedness for their exhaustive work upon the preformed sulphates and indican and their relations with intestinal indigestion. Since then we have the proteids as the source of sulphur compounds, the causation of flatulence can be determined by the increased ratio of preformed to inorganic sulphates and by the excess of indican in the urine. Therefore, flatulence as a symptom, when the chemical evidence of the proteid indigestion is absent, can with reasonable

certainty be referred to amylaceous dyspepsia, with greater reason, indeed, than appears above, because the gastric hydrochloric acid retards bacterial activity, and an excess poured into the intestine markedly interferes with the digestion of starches. Confirmatory of this view is the observation of Kast, that neutralization of the gastric juice with sodium carbonate was followed by an increased ethereal sulphates. Biernacki practically reaches the same conclusion when he says that the excretion of putrefactive products is large, with great decrease of hydrochloric acid secreted. The further suggestion can be made that the gases due to proteid indigestion are sulphur-containing and consequently more obnoxious than those of the marsh-gas series of carbo-hydrate origin. Yet it must be borne in mind that gluten associated with the carbo-hydrates is a sulphur-containing body, so that this distinction is not so important as it would at first appear. Coincident with flatulence are the painful phenomena from heaviness, tenderness, and abdominal discomfort to colicky pains. Since flatulence is more marked with starchy than with proteid indigestion, these symptoms are more prominent. Further, because constipation is an important factor; abdominal heaviness in addition to acute pain is frequently found. Not only are local physical signs, as fullness, tenderness, and changes in percussion note more marked than in proteid indigestion, but the general symptoms are more numerous and persistent. The opportunity for absorption of peccant material—to use an odd term—is favored by the constipation, but as has been stated, the ptomaines of decomposed starch (amulon-ptomaine) are almost as injurious to the human body as the ptomaines of nitrogenous foods. Therefore, we note the lassitude, habitual malaise, general debility (partly from insufficient nutrition) the insomnia, the various sensory symptoms. headaches, vertical, frontal, or occipetal, and vertigo. The heart symptoms are prominent, due in part to gaseous distention, and vary in importance from palpitation, cardiac distress, cardiac pain, and tachycardia to syncope. We have also the urticarias, the muddy complexions, cold hands and feet referable to this cause. We may even observe marked mental changes, as hypochondriasis, intellectual apathy, and morbid somnolence.

The picture is a familiar one but we all have doubtless failed many times in not differentiating this particular form of indigestion, and attributing too much importance to the gastric, to the neglect of the intestinal digestion. After all, the

diagnosis by exclusion, for such must be the method employed, and its accuracy can be readily put to the touchstone of clinical experience. Those in whose persons starch is imperfectly digested, tolerate badly the starched foods. The causes of indigestion of starches are: (1) excessive ingestion of carbohydrates, (2) imperfect insalivation, (3) hasty mastication, (4) too diluted starchy foods, (5) too great gastric acidity, (6) insufficient or perverted secretion of pancreatic fluid, (7) excess or abnormal activity of micro-organisms, (8) intestinal torpor or exaggerated peristalsis, and (9) imperfect absorption of already digested foods.

The diagnosis rests upon the positive evidence of constipation, flatulence, the sensory phenomena, the general systemic disturbances and remote painful symptoms existing in a marked degree, and upon the negative evidence as found in the ethereal sulphate ratio and the amount of urinary indican. The picture seems clearly outlined, and at the close of our study we may say that the diagnosis of the indigestion of starchy food should be reached with reasonable certainty.

THE TREATMENT OF THE INDIGESTION OF STARCHY FOODS.*

BY REYNOLD W. WILCOX, M.D., LL.D.,
OF NEW YORK;
Professor of Clinical Medicine and Therapeutics at the New York Post-Graduate Medical School and Hospital; Visiting Physician to St. Mark's Hospital.

The proper treatment of this form of indigestion takes into consideration its causation. As has been said at another place, the prophylaxis comprises: the limitation of the starches ingested; thorough mastication; which results in complete insalivation, because in this way is the output of saliva increased; and the taking of starchy foods in as dry a condition as possible. By giving careful attention to these conditions, a very considerable number of instances of the indigestion of starchy foods can be relieved. This is the extent to which the treatment of so-called buccal dyspepsia can go in the way of prevention.

The treatment of the indigestion of starchy foods must take into consideration the acidity of the stomach contents, the amount and character of the pancreatic fluid, the influence of intestinal micro-organisms, the deficient or exaggerated peristalsis, and the absorption of the converted starch.

Too great acidity of the gastric contents is unfavorable to starch conversion, because: first, it limits the time during which the ptyalin from the salivary glands acts in the stomach, at best but half an hour, or abolishes it altogether; secondly, the outpouring of an excessively acid fluid from the stomach into the duodenum delays and markedly interferes with the re-establishment of starch conversion by the action of the amylopsin of the pancreatic fluid. In these cases the testing

* Read before the Section on General Medicine of the New York Academy of Medicine, February 18, 1896, and reprinted from THE MEDICAL NEWS, 1896, Vol. LXVIII, p. 393.

of the stomach contents gives a ready solution to the problem, and the neutralization of the excess of acid by sodium bicarbonate in dose from five to a hundred grains, in time varying from immediately to two hours after eating, will rectify this error. Recent papers have shown the harmlessness of even the long-continued use of large doses of this drug; and, further than this, the favor in which this remedy is held by many practitioners is due, not so much to its beneficial effect upon gastric, as to its secondary action upon intestinal digestion. In these cases not only must the proper dose be ascertained for each individual, but the time for its administration is equally important. The methods for ascertaining the motility of the stomach have been so frequently of late the subject of study by clinicians that it is not necessary for me to discuss them at this point. In passing, it is worthy of remark that the action of sodium bicarbonate is solely in neutralization of the free hydrochloric acid in the stomach, the important cause of interference with starch conversion; but it is probably without effect on the acids in organic combination.

Of disturbances of the motor functions, constipation is the rule in imperfect starch conversion. The best method of overcoming this is the administration of a saline in conjunction with an alkali, the latter assisting in the process of conversion. Further than this, as both Wöhler and Miahle have pointed out, the administration of salines will diminish the urinary acidity and quite likely also increase the normal alkalinity of the intestinal contents. The saline, which I have used by preference, is sodium phosphate (the normal, not the acid phosphate) in from 40 to 120-grain doses, to be taken in a full glass of hot water on rising in the morning. To this dose is added 15 to 40 grains of sodium bicarbonate. The advantage which the phosphate possesses over the sulphate is that it is distinctly less disagreeable in taste. As an alternative to these drugs I have used cascara sagrada in various preparations, in sufficient dose to secure a full movement, but I am not satisfied that its action is so beneficial. If gastric acidity is high, then we must in addition administer large doses of sodium bicarbonate during, or immediately after, each meal. Haidenhain has shown that alkalies facilitate pancreatic digestion, and this is the probable explanation.

Diarrhea is by no means common. It is generally due either to obstinate constipation, and alternates with it, or to abnormal activity of the micro-organisms. In the first case,

as a rule, hard masses are found in the stools; in the second, the passages are watery, containing mucus and are of bad odor. If the diarrhea is due to the irritation produced by hardened masses, thorough purgation by the official compound cathartic pill followed by the sodium phosphate mixture is sufficient. If it is due to fermentation, a preliminary purgation with castor oil should be followed by the use of intestinal antiseptics. In either case no opium or any of its alkaloids should be administered, for these only give temporary relief and lay the foundations for a worse condition than previously existed. The so-called intestinal astringents are equally useless. When the fermentation is marked, the expulsion of gas and pain are prominent symptoms. The treatment for the associated diarrhea is given above. In addition intestinal antiseptics should be continually administered. Since the commencement of my studies in 1884, I have made use of a large number of drugs, and their various disadvantages have been determined by clinical observation. Following Bouchard, we can say that naphtol has the best bacteriological basis for its therapeutic use. On the other hand, it is locally irritant, and it also increases the chlorine and generally the hydrochloric acid of the stomach, thus interfering with starchy digestion. Bismuth salicylate is not open to these objections, but unless the kidneys are healthy, this, as well as the other salicylates, is contra-indicated. Another disadvantage is, that this decomposes in the stomach, setting free the salicylic acid. Further, as Gley has shown, unless the pancreatic fluid and bile are discharged in sufficient amount into the duodenum so that distinct alkalinity is secured, the breaking up of such compounds as salol does not take place, and thus the salicylates may be useless. Salol presents another objection from the carbolic acid which it contains. I have used bismuth naphtolate with much satisfaction in these cases; it is not irritant and certainly limits the amount of gas formed, the offensiveness of the discharges, and decreases pain when caused by intestinal distention of gas. The dose varies from ten to twenty grains two hours after eating, administered as a powder or in gelatin capsules. Benzoyl-guaiacol has been used in a few instances, but not with the same success. The importance of intestinal antisepsis does not alone lie in the prevention of gas-formation, diarrhea, and pain, but also in the prevention of auto-intoxication from ptomaine absorption. By these means also the remote effects of systemic poisoning, the

fecal anemia of Clark, neuralgia, vertigo, and the mental symptoms are obviated, and the results of the action of the micro-organisms of proteids resulting in indol, phenol, and skatol, and other aromatic bodies are minimized. The proper method of dealing with flatulence accompanied by pain is outlined above. For impatient individuals, while we are evacuating the offending material and establishing antisepsis of the digestive tract, a plan for affording speedy relief, and one which will not interfere with the action of the drugs in use, must be adopted. This is the administration of the concentrated tincture of avena sativa in a wineglassful of hot water every half hour until the pain is subdued.

The absorption of converted starch takes place rapidly enough if peristalis is normal and mucus is not present in inordinate quantity. The latter is reduced in amount by the use of the sodium phosphate mixture in the manner directed.

The changes in character and amount of the pancreatic fluid have been the cause of various therapeutic expedients, and in obviating the results of these variations, physicians have found many apparently useful resources. At the outset pancreatin should be considered. The preparations, as found in the market, are often inert and, even if not, their action is destroyed in the stomach by contact with the acid gastric juice. To prevent this loss of action, Unna used pills coated with keratin. With this method of administration there is some question if these pills will not pass entirely through the intestinal tract with undissolved coating. It has been proposed to coat these pills with fused salol. The same objection applies to this practice as to the use of this drug for the establishment or intestinal antisepsis. The cases when it is most needed are those of deficient flow of pancreatic juice and diminished alkalinity of the contents of the duodenum, and so the salol would likely prove to be an impervious coating. Probably the best coating is an alcoholic solution of shellac, containing a sufficient quantity of balsam of tolu to impart a proper degree of elasticity, so that cracking of the coating during its drying is obviated; this was the suggestion of Flint. The use of pancreatin then appears to be rather in the preparation of predigested foods than administered as a drug.

Diastase, the maltine of Irwine (1785), Dubrunfault (1823-30), Payen, and of Persoz, has been the subject of much study. As made by Payen and Persoz, it is capable of dissolving, in several hours, fifteen to eighteen hundred times its weight of

cooked starch. This, as other diastases, loses its property of converting starch in the presence of acid, but the degree of acidity requisite is less than the usual gastric acidity. Although its action is favored by alkalies and alkaline salts, yet the caustic alkaline solutions destroy it. As Hayem points out its action is best between 95° F. and 104° F., and the analogy between the vegetable and animal diastase (ptyalin) appears to be complete. The use of diastase from malt was insisted upon by Coutaret (1870), who claimed to obtain great benefit from its use. In cases of gastric hyperacidity, when the action of the ptyalin is suspended in the stomach and when that of the pancreatic fluid is lessened or prevented, the use of vegetable diastase administered with an alkali (sodium bicarbonate) gave good results. This practice was also sanctioned by Boas. For this purpose the following method of preparation has been employed: Three ounces, *i.e.*, three heaping tablespoonfuls of crushed malt, is well mixed with a half pint of cold water in a jug and allowed to stand from ten to twelve hours. The supernatant fluid was then poured off and strained through two or three folds of muslin until the filtrate becomes clear and bright. The yield is about six ounces. The disadvantages of this preparation were found in the necessity of its being freshly prepared. To preserve it, a few drops of chloroform were added to a tightly corked bottle of the liquid. When required for use it should be emptied into a saucer and left in a warm place, when, after two or three hours, the chloroform would be entirely evaporated. A liquid preparation of diastase, which is permanent, has been found in the shops for several years. It seems to possess but little amylolytic activity, due probably to the contained alcohol. The use of malt extracts in the treatment of amylaceous dyspepsia has yielded some very good results, but we are limited to the solid extracts. The liquid extracts generally contain so much alcohol and acids, the results of fermentation, that the action of the diastase is inhibited. At the same time, however, the feeble diastatic power of even the best of them, generally about five times their weight of dry starch, the large amount of inert substances, their deterioration with age, and the fermentation which the large amount of sugar (maltose) which they contain give rise to, are all disadvantages. Further, the pharmaceutical difficulties in the way of using them in mixtures, are obstacles, but not insurmountable ones, to their use in elegant pharmacy. Some years ago (1891) I noted that a malt extract

containing diastase in large percentage had been made by Jokichi Takamine, the Japanese chemist, but I have been unable to find pure diastase of value in the market until during the past year. My skepticism in regard to the value of diastase in the form of a dry powder was based upon the low starchy converting power of a foreign preparation. When I found that a diastase had been isolated by Takamine, and its value certified to by Lascar, I again experimented with the substance. This preparation, according to Smith and Tonkin, is made as follows: Bran of ordinary wheat is sterilized by heat so as to destroy any and all germs which it may contain. After cooling it is mixed with the Japanese fungus, the *eurotium oryzæ*, known as *taka-moashi*, in such proportions as experience shows to be most favorable for the development of the diastatic fungus, *taka koji*. This mixture is kept at the same temperature during the whole of the forty hours it takes the fungus to attain its full development. The *taka-koji* is then washed in cold water, after which the pure diastase contained in the latter is precipitated in the form of a tasteless, odorless, and nearly white powder. Experiments have shown that this diastase possesses the remarkable power of, within ten minutes, converting into sugar one hundred times its weight of starch (estimated in the form of a dry paste), and, within three hours, fifteen hundred times its weight of starch. Its activity is increased by raising the temperature up to 131° F., but no higher. This action is more marked in neutral or feebly alkaline solutions, but is entirely absent in acid or strongly alkaline media. Even when the conditions are in the highest degree favorable the action of the diastase ceases when a certain amount of sugar has been formed. On placing the solutions in a dialyzer, so as to remove the sugar as fast as it was formed, it was found that the action of the ferment more closely resembles the process taking place in the organism, and that a much larger percentage of sugar was obtained than without it.

Lascar has found that he can convert with this diastase one hundred to one hundred and fifty times its weight of starch into a soluble state. Under proper conditions this first named amount is so thoroughly converted in four minutes that neither the iodine test nor the microscope can detect unconverted starch. The starch employed in most of his experiments was carefully washed arrowroot. The final result is, to a great extent, maltose. In this connection especial mention should

be made that an undue employment of heat will destroy the action of diastase. The powder, as found in the market, appears to be permanent, and is used in doses of from one to five grains, as a powder or in gelatin capsules, during or after the meal. Since there is a possibility of the activity of this drug being impaired in its passage through the stomach, although Thompson believes that vegetable diastase continues to operate in acid media, it may be administered as a pill, coated with an alcoholic solution of shellac, keratin, or salol, but the objections noted above will hold here as well. This method, however, I have not found to be necessary.

The following cases, which are briefly reported, illustrate the classes in which we may reasonably hope to derive benefit from the administration of this drug:

I.—July 2, 1895. H. E., aged fifty six years, dry-goods merchant, has suffered for years with dyspepsia. The attacks occur chiefly during his busy season, when hasty luncheons and irregular hours are the rule. On ascending the stairs the dyspnea is so severe that speech is impossible. The eyes are yellowish, dull headaches occur almost daily, and one to three nights each week. The heart is irregular, both in force and rhythm, there is much hepatic tenderness, and the abdomen is resistant and painful on pressure, which gives rise to gurgling. Ten grains of calomel with twenty grains of sodium bicarbonate gave several copious, foul-smelling motions. A pill composed of podophyllin one-quarter grain, iridin one-half grain, and enonymin one grain, was ordered for each night. Bismuth naphtolate, five grains with taka-diastase. three grains in powder, was given after each meal. 10th. The passages being softer and no longer foul-smelling, the bismuth is now omitted. The sleep and palpitation are much improved. August 9th. The improvement continues, and although cardiac irregularity persists, he is not sensible that his heart is abnormal. September 19th. All medication is now withdrawn, excepting the diastase which the patient is positive is also unnecessary. October 5th. On accidentally meeting the patient he announces that he is feeling in excellent condition, having taken no medicine for the past week. The patient might be classified as a buccal dyspeptic.

II.—July 27th. R. C., aged forty years, a merchant attending to a large enterprise, besides representing his organization in attempt to influence legislation, has been a pronounced lithemic for several years. He has been under the care of several physicians, who have generally pronounced him to be *brightique* and have prescribed a vegetable diet. He complains of various neuralgic pains, languor, disinclination to exertion, irritability of temper, constipation, and flatulence. The cardiac first sound is booming, the second accentuated. The urine of sp. gr. 1018, without albumin, sugar, or casts, con-

tains much calcium oxalate and broken-down epithelium. He is directed to make use of a mixed diet, avoiding, however, potatoes, drink one to three pints of an alkaline water between meals, daily, and to take outdoor exercise, short of fatigue. In addition he is to receive taka-diastase in two-grain doses with one grain of citrated caffeine after each meal. August 10th. The patient reports but little change save that constipation and flatulence are better. September 22d. The temper and capacity for work are much improved, and the work is done with less exertion. October 30th. The urine is now of sp. gr. 1022, with nothing abnormal excepting some calcium oxalate. December 9th. The patient reports great improvement over his condition six months ago and feels that he can dispense with medicine.

III.—July 30th. V. E., aged fifty-six, army officer, has been troubled for several months with morning nausea, constipation, distention of the stomach and bowels, more marked two or three hours after eating. There was dyspnea on exertion at all times, but after meals this became more marked, and with it was noticed palpitation. The patient was fleshy, a large eater, and was accustomed to the regular use of whisky in considerable amount, but never to the extent of inebriation. Physical examination revealed an irregular and intermittent pulse, a shortened, high-pitched and metallic first sound of the heart, an accentuated pulmonic second sound, a small liver, the area of flatulence being still more diminished because of the tympanitic percussion note which extended over the entire abdomen; the urine contained a trace of albumin and bile. The diagnosis was, fatty heart, cirrhotic liver, and duodenal indigestion. The patient was directed to limit his starchy foods, bread, potatoes, puddings, and diminish the amount of whisky, and at the same time dilute it. The sodium phosphate mixture was ordered for the morning, a pill of strychnine one-twentieth grain, and nitroglycerin one-hundredth grain, to be taken thrice daily and immediately after eating, taka-diastase five grains in gelatin capsules. August 10th. The patient reports that the flatulence had markedly diminished, and with it the palpitation and dyspnea after meals; the constipation was lessened. The conditions, as found on physical examination, are as before, excepting that the abdominal distention and tympanitic percussion were not so marked. September 12th. The improvement has continued as regards the digestion, although the cardiac symptoms are but little better. October 1st. The constipation is so far relieved that the sodium phosphate can be omitted. The cardiac dyspnea is marked, and insomnia has become a prominent symptom. Beer is now used to the exclusion of whisky. 14th. Albumin has increased in the urine, and the cardiac symptoms are more severe, although the patient has a better appetite and does not complain of indigestion. The diastase is now reduced to two grains per dose. 25th. No dyspeptic symptoms are elicited upon questioning, therefore the diastase is omitted. November 16th. The circulatory disturbances are increasing, necessitating fre-

quent changes in treatment. About two weeks after this report the patient died quite suddenly. This patient suffered from incurable diseases of heart and liver, yet the betterment of his dyspeptic symptoms was too pronounced to be attributed solely to change in diet or to other medication.

IV.—August 20th, W. L., aged forty, lawyer, consulted me to be relieved of excessive flatulence, accompanied by constipation, which had existed for four weeks. He stated that he was a rapid eater, fond of bread and pastry, but of good habits. Physical examination revealed nothing but a sensitive and tympanitic abdomen. He was thin, nervous, and energetic. The urine showed an excess of alkaline phosphates. The sodium phosphate mixture was given, and five grains of taka-diastase in capsules with meals. Besides, the food was to be eaten slowly, masticated thoroughly, and the fluids at meals limited to twelve ounces. September 24th. The patient has been in the country since his first report, and states that he is greatly improved, but that at times only is he annoyed by flatulence. Sodium phosphate is to be omitted. October 17th. The symptoms are now entirely relieved, the urine is normal, and the diastase is omitted. This patient suffered from buccal dyspepsia, and a portion of the relief, at least, was brought about by regulating his habits of eating.

V.—August 3d, H. S., aged forty-four, builder, three days ago, while bathing, suffered from cardiac pain, oppression, and vertigo. For some months he had noticed abdominal pains after meals, flatulence, and dyspnea. At times his vertigo was so severe that he was unable to go about unfinished buildings. The patient was very stout, but his color was good. He was a hearty eater, and was much of his time in the open air. Beyond a rapid and slightly irregular heart-beat, nothing was found. The abdomen was fleshy, yet gave tympanitic resonance in the epigastric region. The liver was distinctly felt below the ribs. The patient's habits as regards large amounts of beer were corrected, and he was given taka-diastase in six-grain doses in capsules. 10th. The patient returns, complaining that the capsules gave rise to great irritation of the stomach, with nausea, followed by vomiting. The dose was diminished to four grains and given in powder form. One-sixth of a grain of mercurous iodide (yellow), was given each night, and a half glass of Villacabras water in the morning. September 14th. The vertigo, flatulence, and breathlessness are improved. October 27th. The iodide and mineral water can now be omitted. The diastase is to be diminished to three grains during a continuance of the improvement. December 14th. The patient experiences so excellent health that all medication is omitted.

The foregoing cases, with a number of others,* have been under observation a sufficient length of time for arriving at a fair conclusion as to the value of the remedy. In but two

*See The Medical Age, 1896, No. 10, p. 299.

instances have been noted any markedly unpleasant results from the administration of diastase. One is recorded above; the other was of a young man who came to me suffering from acute intestinal indigestion from dietary indiscretion, whose symptons were apparently unchanged, excepting increased nausea, after the administration of the remedy.

Nor am I certain as to the proper dosage; it is possible that one or two grains may be amply sufficient; on the other hand, I know of no reason why the maximum dose (six grains) as given above, may not be exceeded with safety. Theoretically that amount should be ample. Personally, I have come to prefer its administration in the form of a powder, and in that form it seems to retain its properties. All important is the diagnosis, that it shall be exact. Accessory means for the relief of by-symptoms should not be neglected.

We may fairly conclude that taka-diastase is useful:

1. In many cases in which the symptoms were wrongly attributed to proteid indigestion.

2. In the vast majority of cases as a substitute for the inefficient pancreatic extracts, malt mixtures and various combinations hitherto employed.

3. For the same relief of amylaceous dyspepsia, which, in the case of proteid indigestion, is obtained by acids and pepsin.

4. As a successful method by which the patients can preserve their nutrition upon a mixed diet.

749 Madison Avenue.